California ISO initiatives to facilitate renewable integration

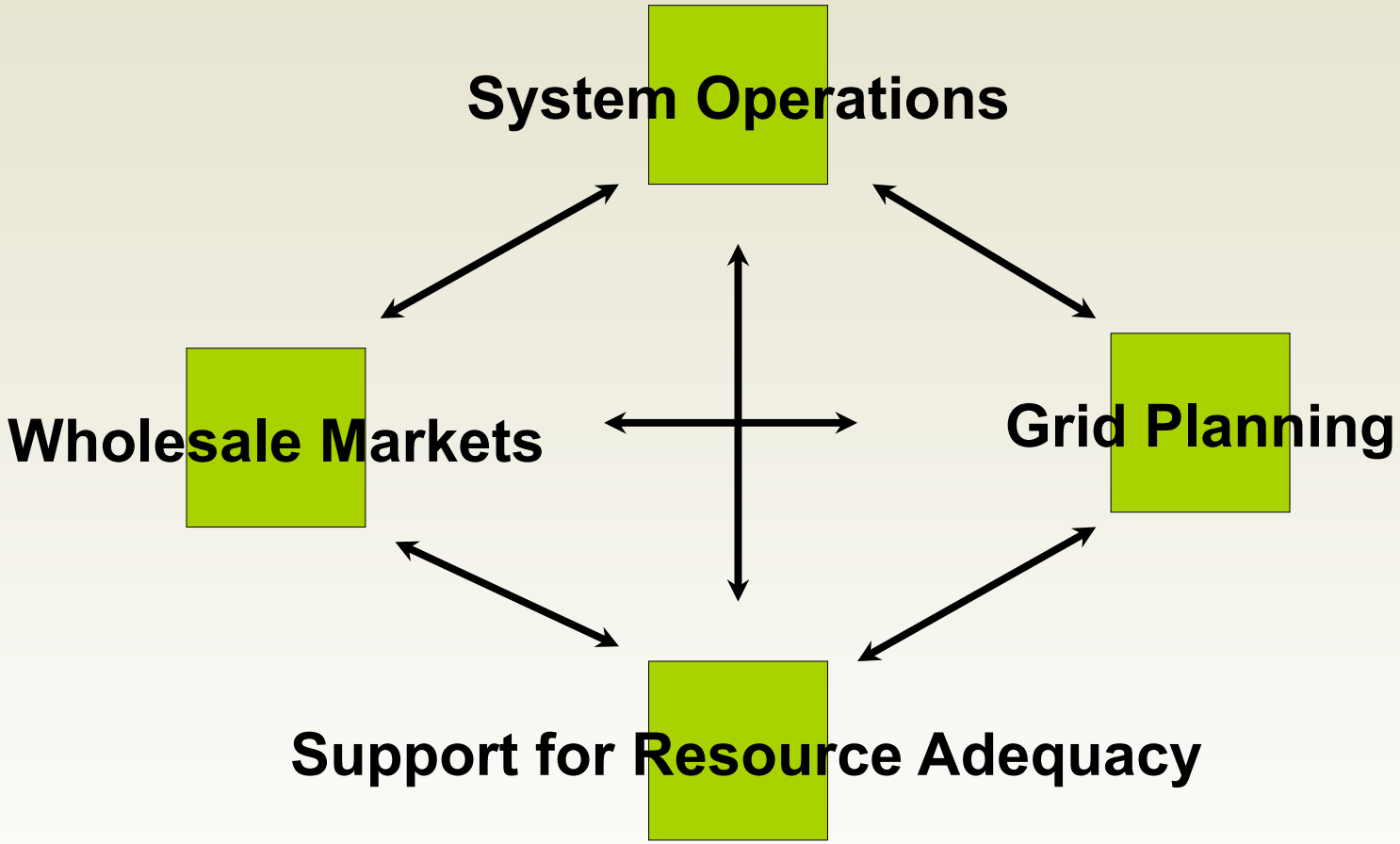
Udi Helman

CEC IEPR Staff Workshop

Technologies to Support Renewable Integration

California Energy Commission, November 16, 2010

ISO is undertaking initiatives across all its core functions to advance renewable and storage integration



Some key objectives and principles for ISO initiatives relevant to demand response and storage

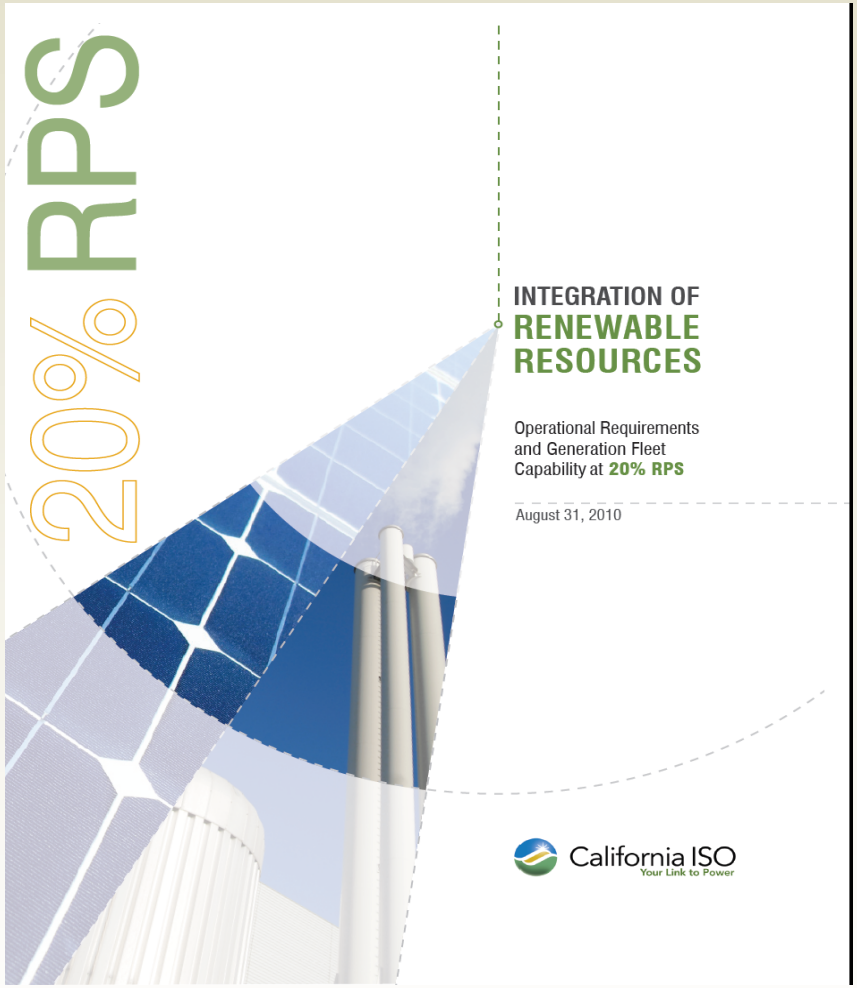
- Provide multi-year operational and market analysis to inform technology and infrastructure investment decisions
- Reduce barriers for demand response and storage technologies to participate in existing wholesale markets and any new market products
- Remain technology neutral: all New market products will not be technology-specific
- Prioritize changes to ISO market and system operations year-by-year

ISO Study of renewable integration at 20% RPS: A 2-3 year look-ahead

- Published August 31, 2010

- First high RPS operational study to consider both wind and solar resources at high RPS

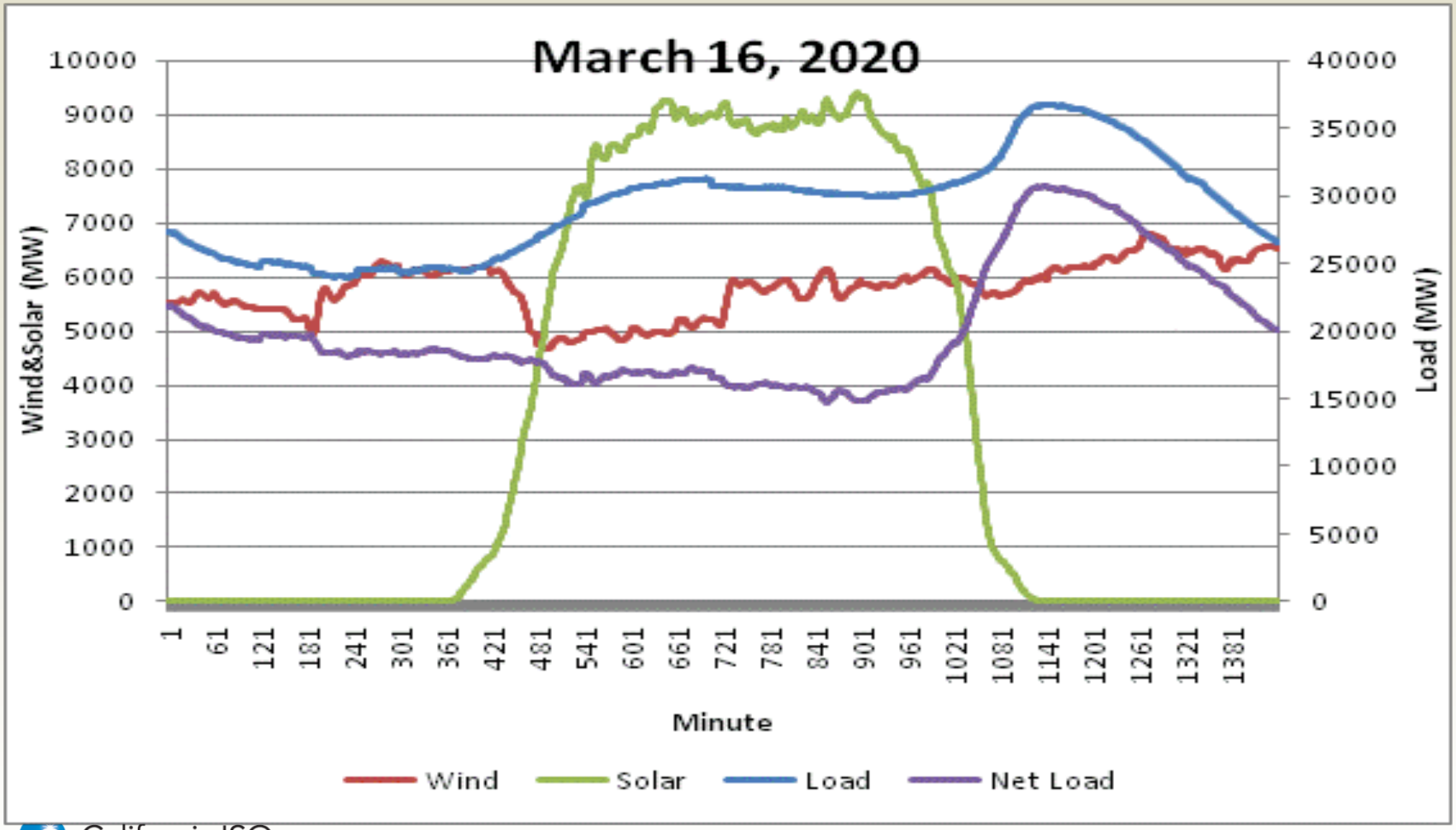
- Study, technical appendix and comments available at http://www.caiso.com/27be/27beb7931d800.html



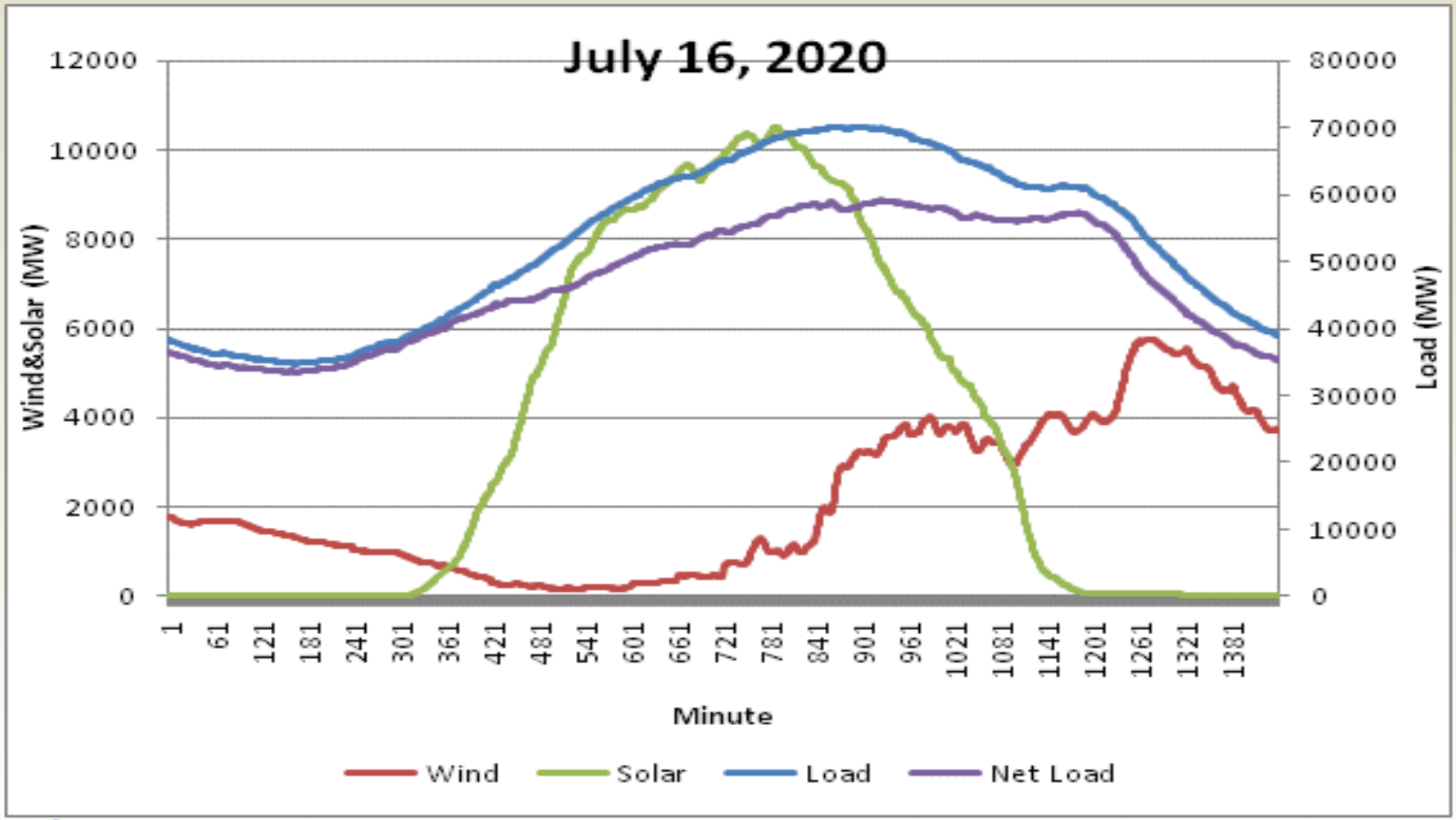
ISO operational and market simulation results of 33% RPS in 2020

- Initial results in PowerPoint format are available here:
  - http://www.cpuc.ca.gov/PUC/energy/Renewables/100824_workshop.htm
- More results to be released at CPUC renewable integration model methodologies workshop on November 30, 2010

Variability increases dramatically by 33% RPS: Simulated profiles for “March 16, 2020”, CPUC 33% Reference Case (2009 version)



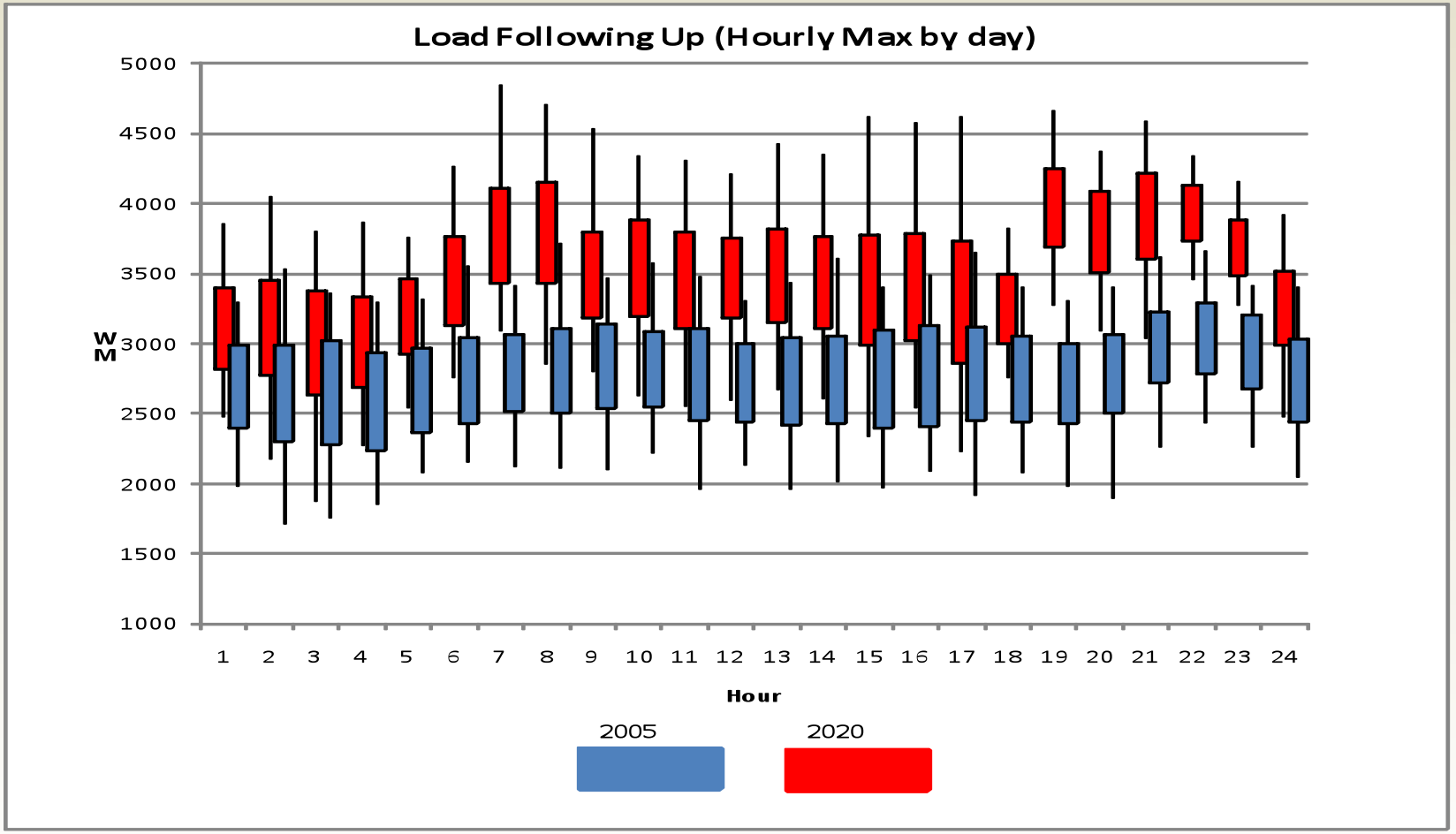
Variability increases dramatically by 33% RPS: Simulated profiles for “July 16, 2020”, CPUC 33% Reference Case (2009 version)



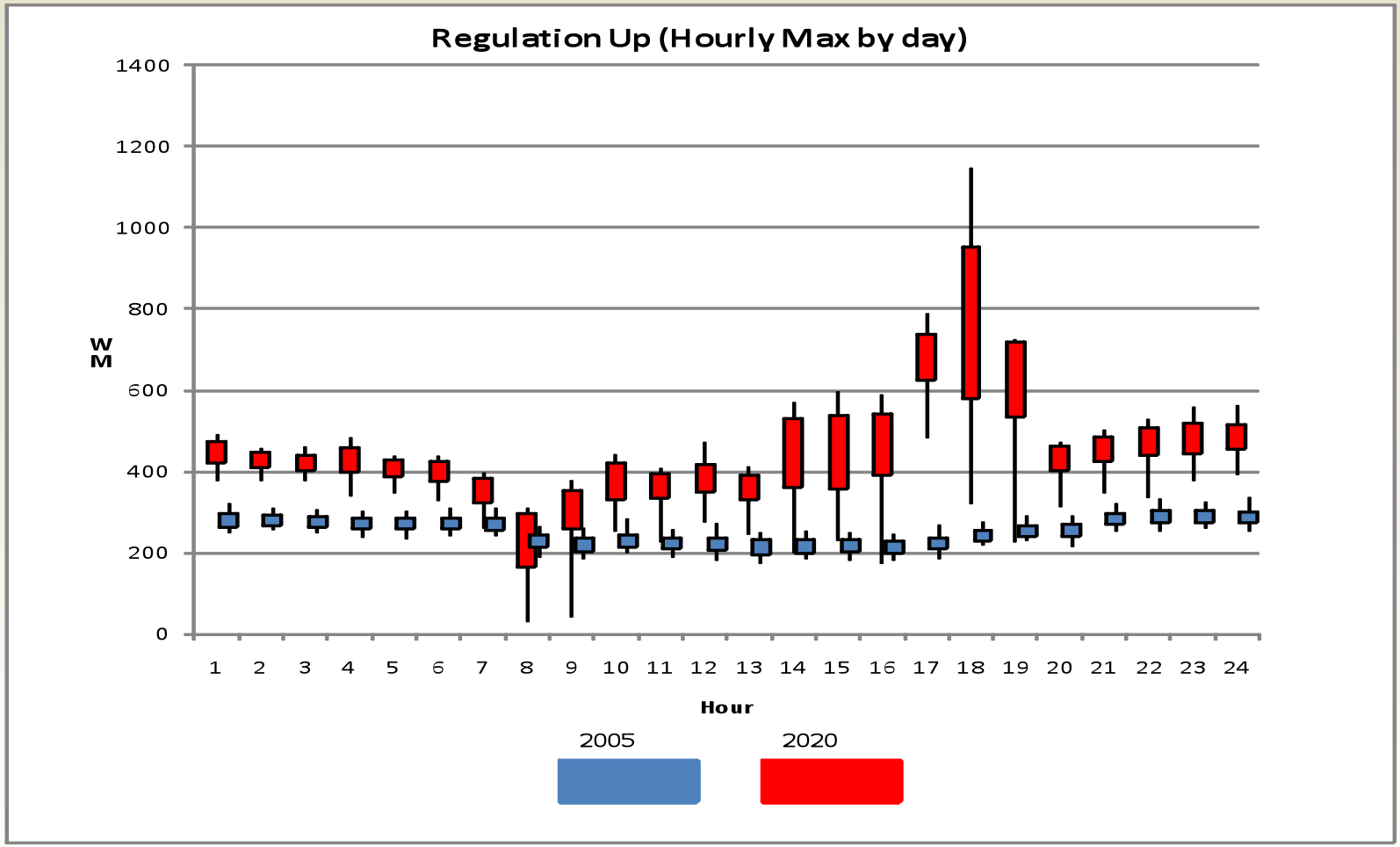
Some key findings from renewable integration studies

- Significant increases in intra-hourly load-following/ renewable-following requirements, varying by season and hour
- Significant increases in Regulation requirements, varying by season and hour
- Energy market prices are expected to decline as renewable energy displaces gas across the day (wind + solar)
  - However, real-time energy prices (load-following) will become more volatile
- Ancillary service market prices will be a function of several factors, including the additional requirements and availability of certified resources

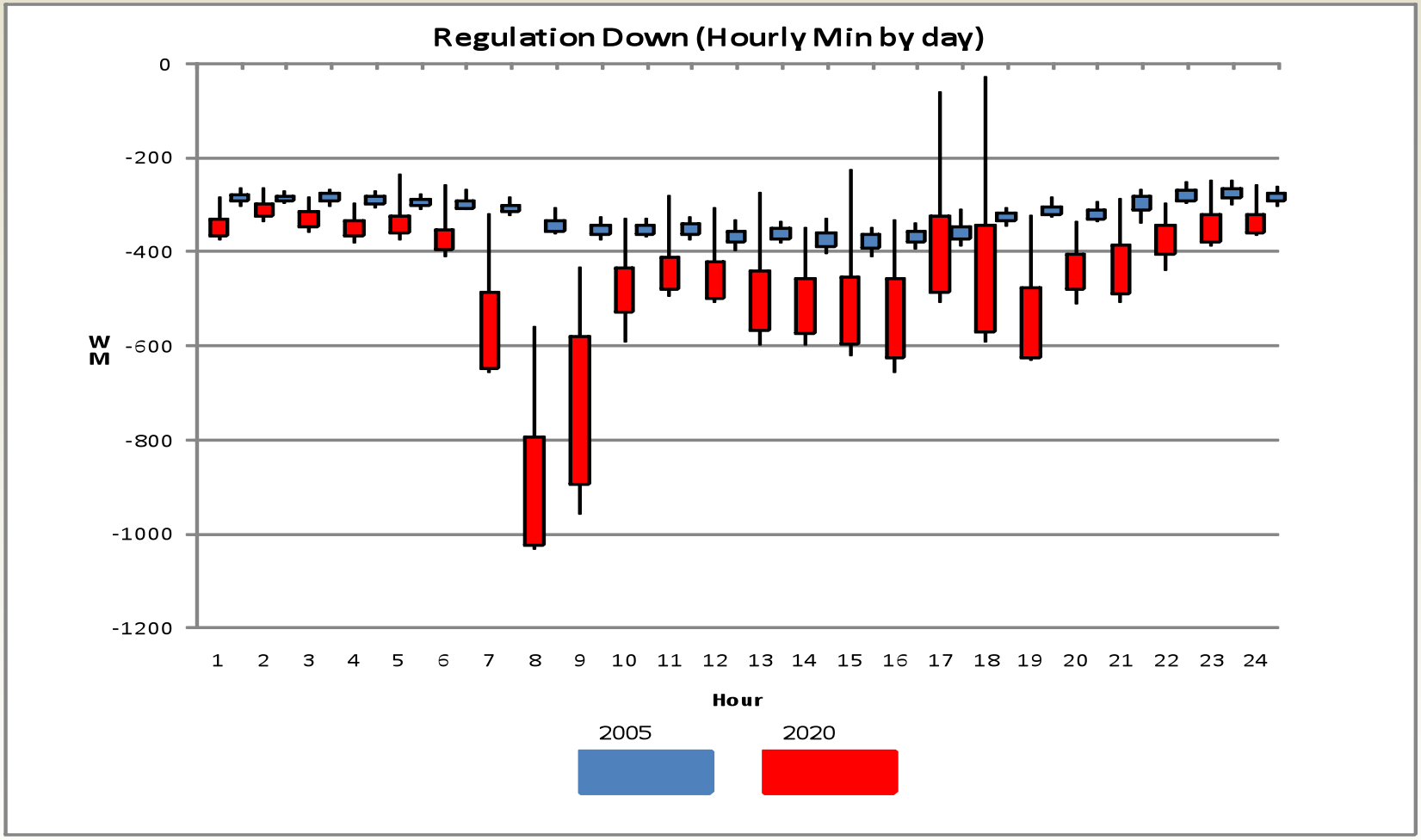
Example: Simulated increase in load-following up under 33% RPS in 2020, CPUC 33% Reference Case (2009 version)



Simulated increase in regulation up under 33% RPS in 2020, CPUC 33% Reference Case (2009 version)



Simulated increase in regulation down under 33% RPS in 2020, CPUC 33% Reference Case (2009 version)



ISO is providing inventories of existing generation fleet capabilities relevant to renewable integration

- By operational characteristic:
  - Ramp rates
  - Start-up times
  - Regulation-certified ramp rates and ranges
- By unit type:
  - Existing fleet, both with and without Once-Through Cooling (OTC) (20% study)
  - Alternative future fleet mixes (33% studies)

Regulation-certified capacity of the ISO generation fleet by ramp rate, 2010

Generation Type		Regulation Ramp Rates (RR) (MW/min) by Category				
		1 ≤ RR < 5	5 ≤ RR < 10	10 ≤ RR < 20	20 ≤ RR	Total MW
Non-OTC Units	Combined Cycle	719	1693	2171	347	4930
	Dynamic Schedule				775	775
	Gas Turbine	20	20	159		199
	Hydro	319	1020	891	1880	4110
	Other				4	4
	Pump/Storage				969	969
	Steam	316	100			416
	Not specified				525	525
Non-OTC Unit Total		1374	2833	3221	4500	11928
OTC units	Combined Cycle		370			370
	Steam	2442	3599	500	1060	7601
OTC Unit total		2442	3969	500	1060	7971
All Units Total		3816	6802	3721	5560	19899

California ISO
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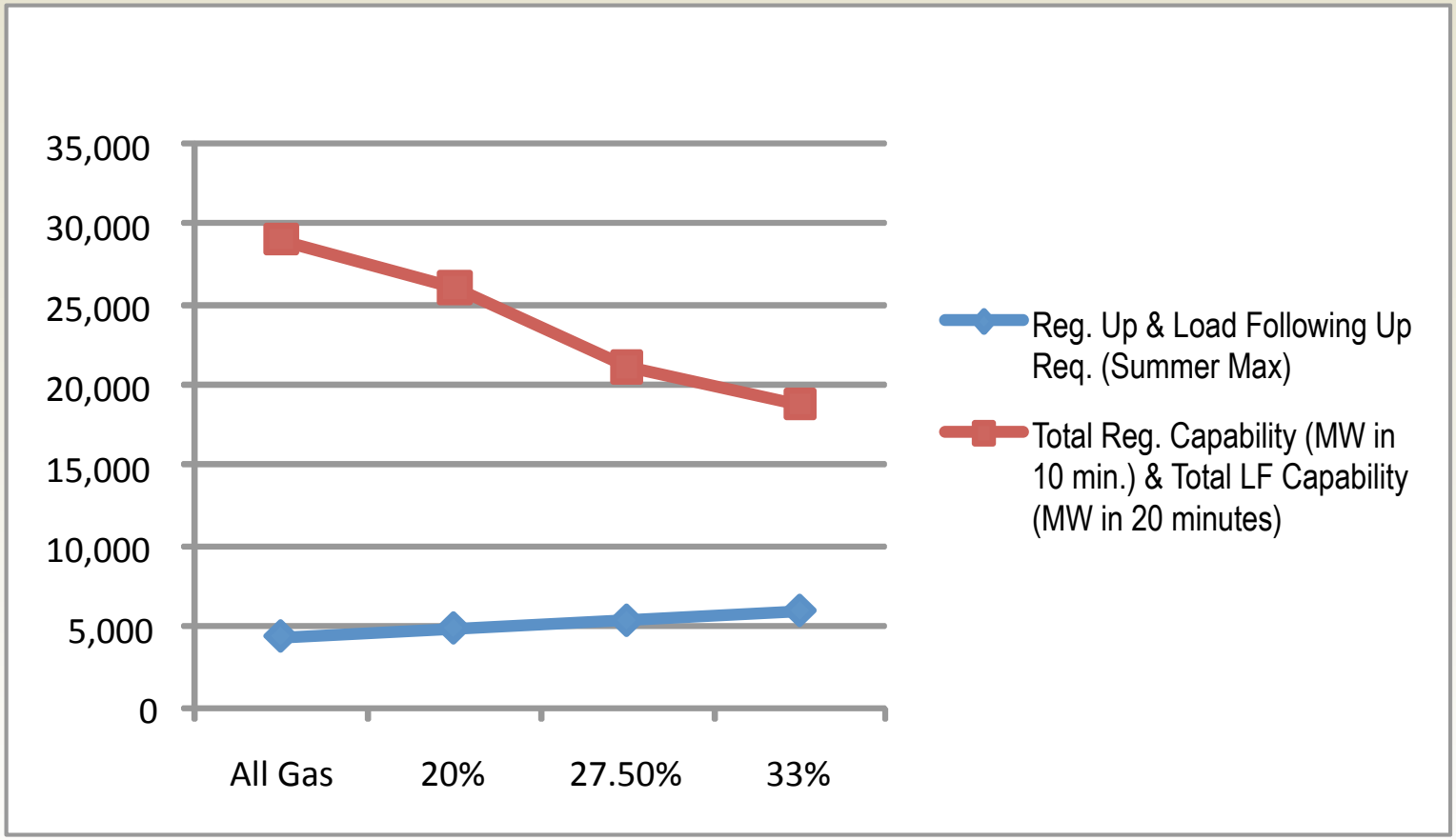
Source: CAISO, 20% RPS integration study, pg. 70

As renewables get more capacity credits, the flexibility capability of the conventional fleet declines

Case Name		All Gas Final	20% Final	27.5% Final	33% Final	High DG PRM Only	High OOS PRM Only
Analysis of All Resources at 17% PRM That Provide Regulation and Load Following							
Total of Regulation Ranges (MW)		22,288	21,271	19,627	18,837	18,237	20,124
Percent Reduction From All Gas			4.6%	11.9%	15.5%	18.2%	9.7%
Total of all Load Following Ranges (MW)		33,458	31,448	28,178	26,618	25,418	29,078
Percent Reduction From All Gas			6.0%	15.8%	20.4%	24.0%	13.1%
Total of all Regulation Capability (MW in 10 minutes)		9,265	8,248	6,604	5,814	5,214	7,101
Percent Reduction From All Gas			11.0%	28.7%	37.2%	43.7%	23.4%
Total of all LF Capability (MW in 20 minutes)		19,811	17,801	14,531	12,971	11,771	15,431
Percent Reduction From All Gas			10.1%	26.7%	34.5%	40.6%	22.1%
Ratio: Total of all Reg Capability to Total of all Ranges (%)		41.6%	38.8%	33.6%	30.9%	28.6%	35.3%
Percent Reduction From All Gas		0.0%	6.7%	19.1%	25.8%	31.2%	15.1%
Ratio: Total of all LF Capability to Total of all Ranges (%)		59.2%	56.6%	51.6%	48.7%	46.3%	53.1%
Percent Reduction From All Gas			4.4%	12.9%	17.7%	21.8%	10.4%

By 2020, operational needs for renewable integration and operational capabilities of conventional resources may be trending in opposite directions*

Total Regulation & Load Following Capability and Requirement at PRM



* Based on analysis that does not consider additional storage

Some Next Steps for 2010-11

- 33% RPS production simulations will produce initial results over the next month, but then substantial revisions to reflect updated CPUC scenarios and methodological changes
- Additional focus on intra-hourly simulation in 2020
- More focused evaluation of storage and demand response in renewable integration simulations
- Market initiative in 2010-11 to introduce Regulation Energy Management for energy limited resources